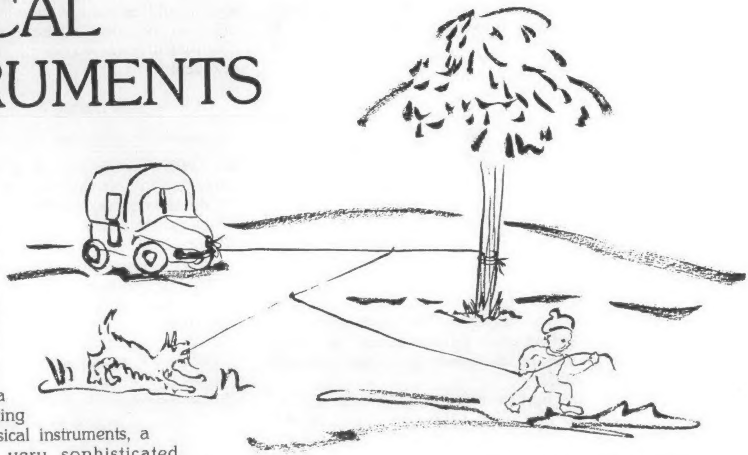
VOLUME VI #6 APRIL 1991 PRICE 3.50

FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF UNUSUAL SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS



ABOVE: Conjoined string systems. See the article on page 12. Drawing by Robin Goodfellow

THE SIMPLE SOPHISTICATE

As always, we have a goodly mix of subject matter for our readers in this issue of **Experimental Musical Instruments**. Included are a look at the musical possibilities of sets of conjoined strings, a discussion of patenting for inventors of musical instruments, a description of a very sophisticated electroacoustic prepared piano, an account of the work of a near-forgotten instrument designer and maker from the 1930s, an approach to tunings and chordings for 19-tone fretted instruments, and the usual complement of additional treasures and throw-aways.

We begin with to the prepared piano.

IN THIS ISSUE

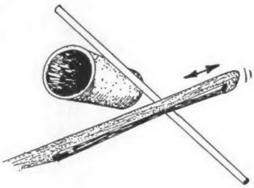
THE ACOUSTISIZER

by Bob Fenger Icon

The Acoustisizer (ACU), simply defined, is a miniaturized prepared piano with guitar pickups and speakers built into the unit, capable of producing prepared piano-generated feedback loops, sympathetic vibration processing and sound-stimulated kinetics. The idea for the ACU developed organically over a period of about five years. As an electronic music composer during the early '70s, I was perplexed at trying to combine and integrate electronically generated sounds with acoustic sounds. Synthetic sounds have an animated or cartoon-like character requiring special handling with their juxtaposition to "real" or acoustic sounds. My first experiments engaged a Pignose amplifier/speaker propped up underneath the family's 1927 Steinway through which I would play my ARP Odyssey. I had a couple of years in which to discover and integrate prepared piano into my experiments before the old grand was finally rebuilt and completely off limits

(coontinued on page 4)

YOU PRINTED A LETTER OF MINE about the Joy Bottle, Bowjo and Thimble [EMI Vol. V #6], so I think I should mention a stick rolled on a can – played with a bow. Any kind of wood works. Pencil size down works best – a pencil will work but not good. A peanut can works good. Equal proportion on the stick helps get proportional sound. About 12" to 6" of stick extending past the can with 4" or more to hold on to gives me the best results. The range is usually around an octave. A good stick will have about three areas producing a range of sounds, but one area will be better. Bowing is best about one to three inches from the can. It may not sound good but it sounds.



Another thing is feedback. I was at a festival where a boy had an FM microphone and was getting feedback. As I tried to explain it to him I found I could get about five notes depending on how close to the radio I had the mike. I know nothing about electronics and somebody may have already made and instrument on this principle but we both had fun with it.

Another simple one I have fun with is a case of drink bottles, tuned with water and played by sticking my fingers in and popping them out – I call them pop bottles. With regular drink bottles you can have almost a three octave range. Playing three or four notes at a time is possible although I don't. I also play them by hitting the top with plastic spoons. You can play faster but it doesn't sound as good.

Maybe one of these days I can write about all the stuff that didn't work.

Tony Blanton

ON RE-READING YOUR LATEST, February 1991, issue of EMI that I received the other day, on page 4 you ask about whether voice announcements of the next item on a tape recording should be made. [The editor raised this question with regard to future cassettes put out by EMI.] Your reason for this, that without the announcement, most if not all listeners will get thoroughly LOST, or worse, MISLED, is practically identical with my reason for putting announcements on my own tape recordings.

I have quite a number of other people's cassettes and disks and reels in my own collection where they inserted announcements. I would have been hopelessly LOST if they had not!

Certain persons have tried to prevent me from announcing in advance each of the 22 different equal temperaments in which I performed on the recent cassette **All Systems Go!** They were mean, cruel and nasty in their remarks attempting to forbid me to announce. So I sent out 38 or more copies of the cassette with the scale-numbers announced before each composition in the Suite. Not one of the listeners all across the country ever objected. This ought to prove my contention that without announcements in recordings of this kind, nearly all listeners would be completely lost, since hardly anyone has ever performed in all these temperaments on the same tape before. Hardly anybody in the world has ever heard all those scales either.

Regarding your question about whether this or that voice style should be used in the announcements, I believe that depends upon the next item on the tape – do each announcement in a mood or style suiting the mood or style of the next item.

Ivor Darreg

RE: AUDIBLE LABELING OF EMI CASSETTES: It might be interesting to note that most of your suggestions for voice possibilities were male, with "Soothing smooth alto" being the closest to an outright suggestion of a woman. Why not have the composer/builder/musician represented introduce their own track. This will give the listener a sense of who the person is. Perhaps give them a time limit (say 10" or less of introduction) so that you don't lose too much time to it. Just a suggestion.

Gino Forlin

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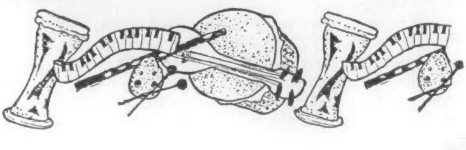
SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles. Include a return envelope with submissions.

NOTES FROM RECENT CORRESPONDENCE

IN OUR LAST ISSUE we ran a letter from Hugh Davies discussing possible sources for a cat music score, a part of which had appeared in these pages earlier in connection with a letter from Dennis James. While the graphic has been attributed to Franz Schubert, he observed, "a more likely attribution is to one of his closest friends, the painter Moritz von Schwind (1804-71)." Hugh has recently managed to locate and send along to us a copy of the complete score in question. We reprint it here.

2nd INTERNATIONAL JEW'S HARP CONGRESS: Frederick Crane is editor of **Vierundzwanzigsteljahrsschrift der Internationalen Maultrommelvirtuosengenossenschaft**, the infrequently published journal devoted to the Jew's Harp which sponsored the First International Jew's Harp Congress in Iowa City in 1984. Professor Crane has written to say that the 2nd International Jew's Harp Congress will take place in Yakutsk, Siberia, from June 18 to June 26 of this year. For more information contact him at 930 Talwrn Court, Iowa City, IA 52246.



THE ACOUSTISIZER

by Bob Fenger

Bob Fenger formulated the idea and constructed the Acoustisizer as a graduate student at Cal State University Dominguez Hills from which he received a Bachelors in music in 1981, and a graduate degree in a special interdisciplinary program in 1983. He has been featured as musician, inventor and performance artist in several periodicals dealing not only with the Acoustisizer and his Mobile Sculptural Units, but also his alternative life style, which has involved transforming an unused area of industrial Los Angeles into a habitable green living space. Currently, he is pursuing a Ph.D. in Systematic Musicology at UCLA, where he plans to do more in-depth research on the instrument featured here as well as pursue performance art from a systematic musicology perspective.

(continued from page 1)

to me. It was not until I acquired an old Humbucking guitar pickup that my experimentation paid off. With the piano strings prepared and the Humbucking feeding these sounds into the Pignose amplifier/speaker lodged underneath the piano, a sort of sound wash was created through which pure acoustic and pure electronic sounds, with the help of sympathetic vibration, could find common elements of timbre compatibility.

Eventually I added delays, chorusing, flanging, overdrives, EQ devices, and a Serge Modular system including envelope followers, slope generators, positive and negative slews, phase shifters, and bi-directional routers; sounds manifested through a series of multi-timbral effects, triggered by a computer-interfaced event synchronizer and blended or processed with the Acoustisizer.

BUILDING PROCESS

My experiments became increasingly complex and it became evident that a dedicated instrument was needed to maintain the necessary consistency and control. The majority of requirements for these experiments could be met on an instrument half the size of a grand piano. I began investigating a number of options including adapting a Frank Hubbard fortepiano kit and even building the instrument from scratch (an engineering feat which would have taken two years longer and as much as sixty thousand dollars). The fortepiano was also impractical because of its fragility. I needed to find a grand piano which would lend itself to reinforced restructuring. The restructuring and reinforcement were to be achieved by using lag bolts and fiberglassing the sides and underbody, which was necessary because of the potentially high levels of volume and vibration generated during the experiments. It took six months of climbing through stacks of old pianos in warehouses all over Los Angeles looking at infrastructural supports and plate configurations, taking notes and making sketches until I came upon an old Viennese piano with a near perfect structural configuration for the project. The infrastructure was made up of workable 90 degree angles; the plate configuration was a simple design and the action was segmented in the right places. The only drawback involved adding a costly metal support to the plate in the bass register. Nevertheless, it was by far the best candidate for the project.

Prior to this project I had never built, cut up, or reconfigured an acoustic musical instrument. The process was painstakingly slow because there was no blueprint or master plan to work from. I had to develop my own method using an evolving sketch pad approach. I jotted down ideas and sketches concerning any aspect of the process and let the idea develop naturally. Every effort possible was made to consider problems which might occur at every step incorporating mockup situations when and wherever possible. All I had to begin with was a vision and a concept which included reducing the size of a grand piano, adding speakers to the underbody and pickups to the strings. But all these modifications were dependent upon the instrument itself and its idiosyncratic construction.

Before disassembling the piano I took a few reference pictures, careful notes and measurements: string height from sounding board, bridge proximity to plate, height of the plate, the amount of down-bearing, damper distance from strings (depressed and relaxed), string gauge sizes and tightness of the tuning pins. Then I followed the Reblitz* procedures for de-stringing and removal of the plate and sounding board which if done incorrectly can result in disastrous consequences, i.e., broken plate, cracked sounding board, pin block damage.

Once the piano was disassembled I drew my lines, triple checked and began cutting with a good hand saw. I cut the long straight side of the piano first so the extra support needed could be added to maintain the integrity of the instrument when the curved side was cut. The pin block was marked and cut with a skillsaw 3/4 of an inch longer so that a matching cutout in the first plywood layer could act as structural support for the pin block (FIG. 1). This first layer of plywood was veneered with white spruce on the side facing the inside of the instrument and held in place with seven 3- and 4- inch lag bolts. Four more 3.5 inch bolts, nuts and washers secure a 2x2 shelf inside the instrument for the sounding board and plate (FIG. 2). The second 3/4 inch plywood skin was applied with wood glue and lag bolts as well. Lag bolt positions for both skins were calculated to work together for maximum strength before either skin was applied. The same procedures for cutting the long side applied to the small side. Once both sides were glued and lagbolted in place, I restructured the front underbody which housed the keyboard action using 90-degree rabbet joints. I then stripped the curved section and filled, sanded and shaped the sides together. Any little crack, crevice or separation in the wood needed to be repaired before applying the fiberglass. Repairing the separating laminations on the curved side presented a problem which was resolved by situating the instrument so that its own weight held the curved laminated area in place while the glue dried. A variety of different sized wood wedges helped to apply pressure at vital points.

The prep work prior to fiberglassing was critical as fiberglass tends to magnify any flaw in the wood. I chose to use Dynell fiberglass cloth and Cal System two-part epoxy resin because it is easier to mix and the set-up time is consistent. I did the easier long flat side of the instrument first. The inside was masked off, the cloth cut and laid in place and the

The piano before the saw.

FIG. 1: Pin Block cut out.

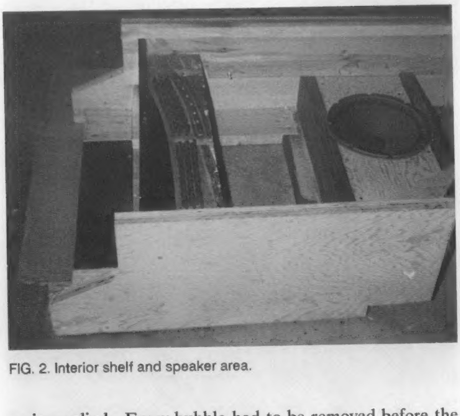


FIG. 2. Interior shelf and speaker area.

resin applied. Every bubble had to be removed before the resin set (12 minutes). The curved side was more difficult. After the resin had set, the borders were cut and cleaned and the masking tape removed before the tape itself turned into fiberglass. The final prep took many hours of polyfilling and sanding before the sun yellow epoxy paint was applied (i.e., mixing epoxy with micro-spheres, applying it to pitted areas, letting it set, then sanding it). Finally, epoxy finishing paste and fine emery cloth were used to finish the surface. I found a professional painter to spray on the final coat of epoxy paint. A professional painter can prevent you from wasting hours of prep work and many spray nozzles, as epoxy paint is expensive and extremely difficult to work with.

Once the plate was free of all piano wire and felt rings, it was cut by a machinist and sand blasted. A 23.5 mm mid-range hitch pin section was left unsupported as a result of the cut, so a 1.5 mm x 32.8 mm case-hardened piece of stainless steel was attached supporting this hitch pin section to the section above it. The plate was painted radiation purple then pearlized in order to soften and add depth to the color.

The sounding board required the most time and care in preparation. The easy part was cutting it down and repairing the cracks; Reblitz is quite thorough in his discussion on this subject. The problem began when I realized that I had reduced the area of the sounding board and thus the question of the rib size became an issue, since the ribs reinforce the sounding board. Too much support could alter the way sound acted upon the sounding board and potentially deaden the sound. I resolved the problem by calculating the amount of mass removed from the two sides of the sounding board and removing approximately the same amount from the rib structures, thus scaling the sounding board down proportionately. The last step in preparing the sounding board was applying the proper finish. It is generally accepted by expert piano rebuilders that varnish is the best finish for sound boards because it remains more flexible after it dries than shellac or lacquer, and does not restrict the vibration of the sound board as much as the other types of finish do. I applied only one coat of varnish to the top and bottom, ribs included.

The keyboard action in the instrument is considered a Vienna action, originated in 1717 by Christoph Schroter, a contemporary of Bartolomeo Cristofori. Schroter's action was later improved upon by Gottfried Silbermann and his pupil Johann Andreas Stein. Silbermann did away with the special escapement lever and extended the hammer butt beyond the axis, using this extension for escapement. Stein added the "hopper" by aid of which the annoying "blocking" of the hammer was overcome, at the same time improving the touch. The action is considered a single escapement and is quite simple in comparison to the modern day double escapement actions (FIG. 3A). This action dates the piano at somewhere between 150 and 200 years old.

I cut off exactly 2 octaves of the action from the bass and one note less than 2 octaves from the treble. Once again, I marked all the parts, then dismantled the action. The cuts were made leaving an inch and a half for the side supports which were cut and shaped out of a 2x6. The relative simplicity of the action

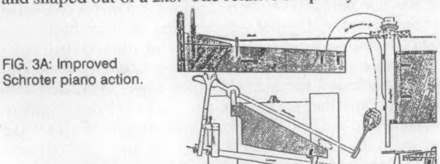


FIG. 3A: Improved Schroter piano action.

*Arthur A. Reblitz' book **Piano Servicing, Tuning and Rebuilding** (Vestal Press, Vestal, NY 13850) is a standard resource for the piano technician.

made this task easier than expected (FIG. 3B).

The speaker cabinet built into the underbody of the instrument is split in half by a 90-degree support brace. One section houses one 12-inch speaker; the other section houses four 4-inch speakers, one 4 inch JBL LE 25 mid-range and one 3-inch high frequency horn (FIG. 4A). Originally, the seven speakers were tied together through one passive crossover (FIG. 4B). Recent experiments have incorporated a patchable multi-channel system in an effort to achieve discrete feedback zoning, allowing a number of prepared strings to feedback independently of one another. This process involves an isolated transducer above the string and a speaker focused below the same set of strings with its own amplifier. An audio mixer with filter parameters help control harmonic accentuation, optimizing feedback perpetuation of the prepared string and eliminating the sometimes annoying high pitched squeal normally associated with feedback.

The final phase involved assembling all the parts. I was immensely relieved to find that the nosebolts which ran up through the bottom support, through the sounding board and through the plate maintained their alignment. Again, I followed the Reblitz book for stringing the instrument. This involved bringing the whole instrument up to relative pitch gradually, but because my primary interests were in creating electromagnetic sounds and noises, traditional tuning systems have no application. I inevitably tighten and loosen strings at every stage of the process when searching for sounds with a new preparation.

Final touches involved lining the bottom and keyboard action compartment with acoustic carpet, hinging on a 2-part half-inch plexiglas lid, and imprinting the Acoustisizer logo to the flat black pin block front.

Originally two transducers (guitar pickups) were connected to flexible microphone arms attached to the inside wall of the ACU. This system was eventually replaced by simply attaching legs to the pickups and resting the legs on the soundboard (FIG. 5). Presently plans are in the works for a series of experiments involving home wound pickups, some of which will be ten times larger than guitar pickups with a multi-versatile mounting system incorporated into the design (the basis for this modification will be discussed in greater detail in the section on ACU preparations).

ACOUSTISIZER PREPARATIONS

In 1977, Richard Bunger wrote a series of informative articles for **Contemporary Keyboard Magazine** on the history and safe technique of piano preparation ("Prepared Piano: Its History, Development, and Practice," in **Contemporary Keyboard** Vol. III #7, July 1977, Cupertino, CA). He cited the 300-year parallel evolution of pianos and mutes consisting of felt, leather and paper which contributed to the piano's ability to assume various tone colors and allowed such composers as Maurice Ravel to transform an ordinary piano into an insect-infested harpsichord. John Cage, attributed with the invention of the "prepared piano," acknowledges his mentor, Henry Cowell, and his use of hand muting and finger string manipulation. Cage confesses openly that the prepared piano was the result of space limitations at a given venue involving dancers and an African motif. By 1981, Richard Bunger and his Extended Piano Resource Project had documented over 200 works that feature piano-string preparation and muting, representing about 200 composers throughout the world.

So where does the ACU fit into this concatenation of events? In **The Well Prepared Piano** (Santa Rosa, CA: Litoral

FIG. 3B: Finished ACU action.

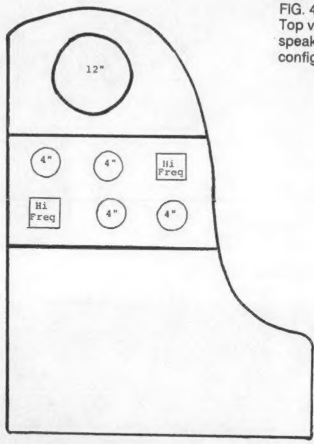


FIG. 4A: Top view – speaker configuration.

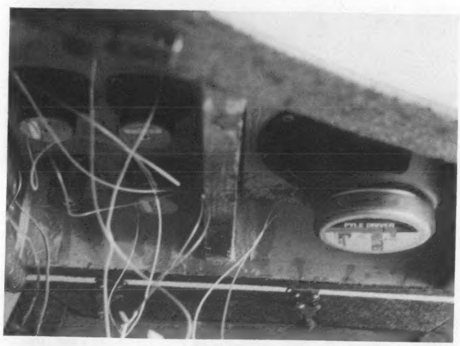


FIG. 4B: Bottom view – speaker network.

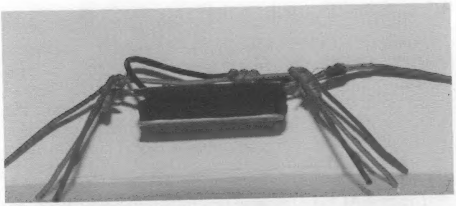


FIG. 5: Pickup with legs

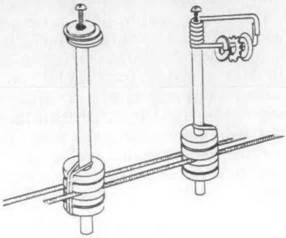


FIG. 6: A hybrid string preparation

Drawing by R. B. Evans

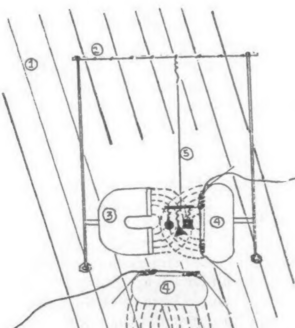


FIG. 7: Suspended objects within opposing magnetic fields.
1. piano strings
2. bridge tree rack
3. magnet
4. pickups
5. kinetic oscillator
6. speaker

Dra ving by Jowee Jiao

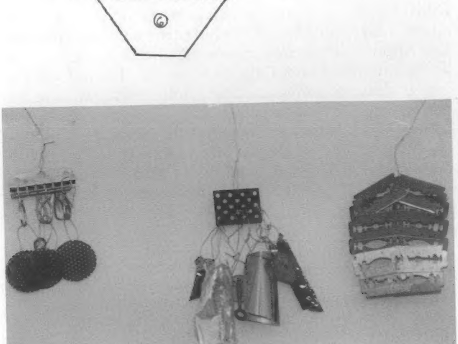


FIG. 8: Kinetic oscillators

Arts Press, 1981), Richard Bunger has succinctly described many of John Cage's original preparations and designated them into five groups: A) metal: bolts, screws, washers, coins, wire, u-bolts and metal strips; B) wood: bamboo, clothes pins, paper and cardboard; C) cloth: various felts; D) rubber and plastic: canning jar washers, piano tuners rubber mutes, rubber pencil erasers, wiring insulation, foam rubber, sheet plastic, rubber and plastic washers; and E) hybrid preparations, combining a number of the items from the first four groups, connected to the strings and extended above the strings (FIG. 6). It is from these hybrid preparations that I drew inspiration and secured the ACU's logical sequential position.

In the beginning of this article I mentioned the ACU's use of feedback loops. The feedback aspect of the ACU is best defined in the context of the electric guitar, and is actually a by-product of amplification and overtone accentuation causing electro-magnetic perpetual oscillation of a given string. Sound from the string is picked up by a guitar pickup consisting of a wire coil wrapped around a magnet, then fed to an amplifier and finally to a speaker, where the sound continues to perpetuate the motion of the string, whose motion is once again sensed by the pickup. The intensity of the electromagnetic perpetuation of the oscillating string is controlled by the volume level through the speakers or, in the case of the guitar, the proximity of the guitar to the speakers. Touching the string with your finger will either mute the process or allow one of the overtones to sound in isolation. Because of the potential precision control over the vibrating string as a link in the electromagnetic chain, this effect adapts itself nicely to musical applications. This is exemplified in the opening crescendo of Jimi Hendrix's "Foxy Lady" (from the record album **Are You Experienced**, Reprise Records, a division of Warner Bros. Records, Inc., Burbank CA and New York).

In the ACU, speakers are located in the underbody and point up towards the sounding board. Magnetic pickups are suspended above the strings. This close proximity between the speakers and the pickups creates a reflective or cyclic magnetic field causing strings and objects in or around the strings to vibrate. Another type of vibration can be induced in objects by grouping a number of guitar pickups together and using a strong opposing magnet. Two magnetic sources of the same polarity generate magnetic fields which repel each other and in the process agitate objects suspended between them (FIG. 7). I call the suspended objects *kinetic oscillators* (FIG. 8) and the objects to which the magnets are connected and the kinetic oscillators are suspended, a *bridge tree rack* (BTR). The BTR is made up of two twelve-inch-long #8 or #10 threaded rods bridged together with a windshield wiper frame and bolted to the strings. The windshield wiper frame works well because of its lightweight open looped construction allowing easy kinetic oscillator suspension (FIG. 9).

Sounds produced by kinetic oscillators are similar to the buzzes, jingles, rattles, and scrapes of John Cage's preparations except the generation of the sound is not limited to a single keyboard activated event. Kinetic oscillators vibrate continuously as long as the opposing magnetic fields remain intact and the amplified sound is regenerated through the pickups which are pointed towards the strings and speakers. These suspended objects or kinetic oscillators must contain some sort of light weight metal component in order to vibrate within the agitated magnetic field. Kinetic oscillators which do not contain metal components must rely on their proximity to vibrating strings for sound generation.

Using guitar pickups grouped together as described above

FIG. 9: Kinetic oscillator suspended from bridge tree rack.

does create some significant limitations: a) the grouping is somewhat cumbersome and hard to manipulate; b) the agitation created within the magnetic fields is limited, which in turn dictates the size of the kinetic oscillator. These limitations should be overcome by increasing the size of the magnet in the pickup and therefore increasing the strength of the magnetic field. This will reduce the number of pickups required to produce the agitated magnetic field and allow more precise placement of the field.

Almost anything imaginable can be used in the construction of a kinetic oscillato depending upon the desired sound: different sized brass tubing, rubber bands, paper and combs, double-sided razor blades wired together and even cellophane or aluminum foil folded, spindled or shredded into a sort of mixed media origami. Muting selected vibrating surfaces within the kinetic oscillator with string or scotch tape can achieve fine tuning and eliminate unwanted extraneous sound. Scotch tape can also clean up unwanted vibrations produced by the standard woven coin preparation (wedging a coin between three strings by weaving it over one, under the next and over the next). Just wrap a piece of tape around the coin before weaving it into the strings. This technique was first introduced to me by a pianist named Shirley Hoffman during her preparation for a performance of Richard Bunger's "Money Music" in Los Angeles in 1982. You can actually use all different kinds of materials for muting besides string, scotch and drafting tape, including: cotton balls, felts, cloths, alligator clips with taped teeth, video head cleaning swabs, and, in rare cases, silicon adhesive and hot glue.

The challenging factor in this kinetic sound game is the extraction and amplification of specific vibrating surfaces within the kinetic oscillator. There always seems to be some tantalizing sound just out of reach of amplification. I have thought about selective enhancement through sampling, but fear the subtleties achieved through hands-on interaction with the magnetic fields could be lost to limited sampling lengths. In many cases the longer hand-manipulated aperiodic sound events are the most interesting.

With a little imagination, a scaled down version of the ACU and the kinetic properties described herein could be applied and experimented with at home. Possibly an old electric guitar, acoustic guitar, dulcimer, etc. could be butchered, I mean transformed into some kind of kinetic feedback generating device. Read back issues of EMI, there are all kinds of instruments and ideas with infinite possibilities just waiting to be acoustisized.

ACOUSTISIZER KINETIC INSTALLATIONS

Initially the ACU was developed as an answer to an electro-acoustic composition and performance problem. It was through further work with the instrument that the kinetic aspects were revealed. These aspects, in combination with the instrument's unique aesthetic appearance, prompted a series of art gallery installations. Eventually, installations involved performance and evolved beyond the confines of the gallery and theater.

The first ACU installation was in November of 1982 and involved the discarded cut off parts of the instrument on one side of the stage and the ACU on the other. Suspended above the strings was a mobile made up of wood, metal and plastic pieces attached by strings to the inside of a series of small speakers suspended from the lid. Sounds from the mobile pieces making contact with the strings inside the instrument were amplified and directed back to the mobile's speakers and then to the house speakers creating a crude self-perpetuated electromagnetic kinetic sound sculpture. The second part of the program consisted of processing electronically generated sounds through the Acoustisizer and then amplifying the sympathetic vibrations through the house speakers.

After a series of ACU installations over a span of about a year a radicalization of approach was mandated by painful reality. Not only was the ACU heavy and cumbersome to move, it also required a minimum three-hour setup time. The principle of consistency and predictability on which the ACU was originally based was gravely jeopardized by a complicated tedious setup. I decided after an installation at Angel's Gate art gallery in which the ACU and six anvil cases were carried up a flight of stairs, that some sort of mobile unit was necessary in order to maintain the ACU and its peripherals as a mobile integral unit. I had to work fast if I was to enjoy a functional back beyond the age of thirty-five.

In November of 1986, I introduced a number of friends from Dominguez Hills to friends at UCLA and organically formed a collective/art task force entitled Group of People (GOP). GOP staged a number of guerrilla performances around LA and in the process developed a spontaneous mobile theater. I shared my mobile unit idea with the group, and in January of 1987 located and purchased an old beer truck for $200. I began cutting and shaping it into a semi-trailer with stage extensions on the sides, front and roof. By September the unit was ready. It assumed the name "Mobile Sculptural Unit" (MSU) and was used extensively by GOP in a series of strategically located Fringe Festival performances throughout Los Angeles. Performances coincided with concerts at the Triforium Plaza (John Cage Celebration), Lhasa Club and various dance performances held at lofts downtown as well as performances at MacArthur Park.

Presently, the unit is undergoing changes once again to serve the ACU more specifically with modifications which will broaden the ACU kinetic concepts to include found acoustic spaces around LA and expose the beauty of the decaying urban landscape.

Inquiries can be directed to Bob Fenger Icon, 2415 S. Santa Fe #16, Los Angeles CA 90058.

The author thanks the following people for their help with this article: Jowee Jiao for research organization, editing and illustrations; Paul Evans for the hybrid preparation drawing and continued encouragement and support; and Wanda Bryant for final editing contributions.

TUNING FOR 19 TONE EQUAL TEMPERED GUITAR

by Bill Sethares

There are two ways to acquire a 19 tone equal tempered (ET) guitar: refret your old strat, or mortgage your mother to buy a MIDI guitar controller and suitable sound module. In either case, it is an instrument for which no "how to" books are available. How to best tune the strings? How to play a major scale? How to play a minor seventh chord? Guitars tend to be chordal instruments. Yet a 19 tone ET beast is unhappy with standard chord fingerings and is soured by tried and true scale runs. This article reports some explorations with a 19 tone ET guitar and proposes three "alternate" tunings, along with scale and chord charts. Some general strategies emerge for finding useful tunings for the strings when confronted with a new temperament.

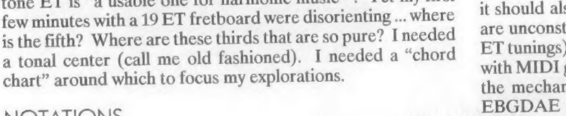
WHY 19?

From a just intonation point of view, 19 is a sensible equal temperament because it gives greater purity of major and minor thirds (and their inversions the major and minor sixths) than 12 tone ET, yet it does not have an overwhelmingly large number of pitches per octave. Tim Perkins comments that 19 tone ET is "a usable one for harmonic music"[1]. Yet my first few minutes with a 19 ET fretboard were disorienting ... where is the fifth? Where are these thirds that are so pure? I needed a tonal center (call me old fashioned). I needed a "chord chart" around which to focus my explorations.

NOTATIONS

The 19 tone equal temperament is built around the $\sqrt[19]{2}$ (the nineteenth root of 2, which is about 1.037) in the same way that 12 tone equal temperament is built on $\sqrt[12]{2}$. This implies that the octave is divided into 19 equal steps which are about 63.16 cents apart, a little more than half a standard semitone. For nice discussion of this tuning (and many others as well), including a chart with all 19 tones specified in cents and in ratio intervals, consult Scott Wilkinson's **Tuning In**[2].

19 tone ET is closely related to 12 tone ET and provides a solid bridge from familiar tonalities into unfamiliar. One point of similarity is that standard musical notation can be easily extended to the 19 ET setting. John Chalmers' April 1989 article in **Experimental Musical Instruments**[3] states that the following mapping of note names to scale pitches is "favored by many current 19-tonalists."



Indeed, choosing a scale made up of the 19 ET pitches C,D,E,F,G,A,B,C provides a close approximation to the 12 tone ET major scale. Thus, much of standard music theory can be appropriated directly to describe 19 tone ET events.

For most purposes, 19 tone ET chords can be defined by analogy with 12 tone chords, and these chords will tend to function musically in a familiar way.[4] This makes the creation of a "chord chart" for 19 tone ET fretboards relatively straightforward. For example, a major chord in root position consists of a root, the tone 6 steps higher, and then the note 5 steps higher. Thus, C-E-G and D#-Gb-A# (but not D#-F#-A#) are major chords. Similarly, minor chords are defined as a root followed by the tone 5 steps higher and then the note 6 steps up. Thus C-Eb-G and D#-F#-A# are minor chords. Analogously, major and minor sevenths, dominant sevenths, major and minor sixths, ninth and diminished chords can all be defined. These provide a solid starting point from which to conduct explorations of the 19 tone ET fretboard.

NEW TUNINGS

Guitar players instinctively tune to EBGDAE, as if these letters form a sacred mantra. Why is this guitar tuning standard? Where did this strange combination of a major 3rd and four perfect 4ths come from? There is a bit of history (view the guitar as a descendant of the lute), a bit of technology (strings which are too high and thin tend to break, those which are too low tend to be too soft), and a bit of chance. Even supposing that EBGDAE is optimal for a 12 tone ET guitar (and this is a big supposition), there is no obvious reason why it should also make a good tuning for 19 tone ET beast. We are unconstrained by history (since there is no history for 19 ET tunings), and the technological constraints are different ... with MIDI guitar controllers, tunings need not be confined by the mechanics of string widths and neck tensions. In fact, EBGDAE makes a relatively poor 19 ET fretboard tuning. There is only one way to finger major chords, and there is no way to comfortably finger minor chords. We can do better.

In the accompanying figures, you'll find my three favorite "alternate" tunings for use with 19 ET guitar. The All Fourths tuning, first used in my composition "Incidences and Coincidences"[5], is a regular tuning that keeps much of the feel of EBGDAE while providing easier fingerings for most chords. The Accidental tuning was born along with the song "David, Please Stop Talking" and is the sort of tuning one is likely to stumble on serendipitously (I did). Finally, in the Open Minor Seventh tuning, the six strings are tuned to a minor seventh chord. This worked particularly well in the composition "Law of Love."

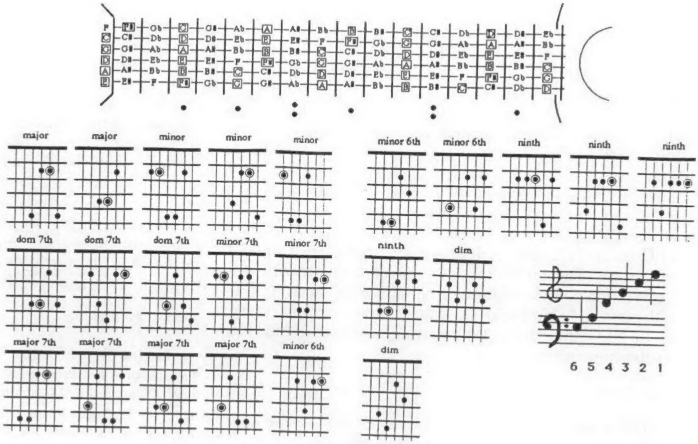
In these figures, you will find a definition of the tuning in the 19 tone ET notation outlined above, a diagram of the guitar fretboard with the note names displayed along with a highlighted major scale, and a selection of interesting chord forms. All chords are "bar" chords in the sense that they are moveable up and down the fretboard and the root of the chord is circled. Of course, placing the lowest indicated tone at the nut gives an open chord form. For those whose fingers are less nimble, the open forms are generally easier to finger.

THE ALL FOURTHS TUNING

Guitarists are used to hearing a perfect fourth when moving fingers from string to string at the same fret. The All Fourths tuning maintains this element of familiarity. In addition, the tuning is regular, that is, the strings are equally spaced in pitch. This means that any finger pattern can be moved up and down on the neck (like a normal bar chord) and also sideways across the neck. For instance, the "pattern" of the four high strings of the Db major chord below can be shifted one string down to form an Ab major chord, and can be shifted down yet another string to form an Eb major.

Similarly, any of the All Fourths chord forms can be moved from string to string, as well as from fret to fret. Regular tunings greatly simplify the learning of chords, since each finger pattern is useable for several different chords.

The All Fourths Tuning

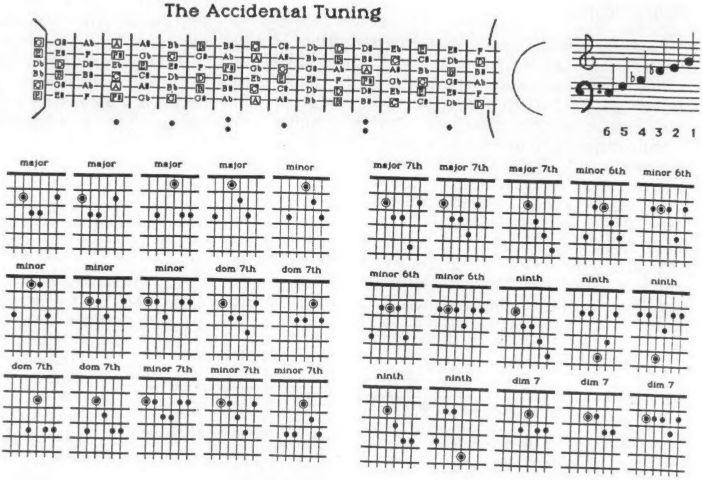


THE ACCIDENTAL TUNING

Retune a synthesizer sound module to 19 tone ET. Plug in a MIDI guitar controller, leaving it in its standard tuning. You have discovered the Accidental tuning. The controller sends its normal MIDI note numbers, i.e., low E = MIDI note 40, low A = MIDI note 45, but the sound source interprets each step as a 19th step rather than a 12th step. Thus, MIDI note 45 sounds a G and not an A. Similarly, the rest of the fretboard is compressed into the accidental tuning ... E, G, Bb, Db, E, G.

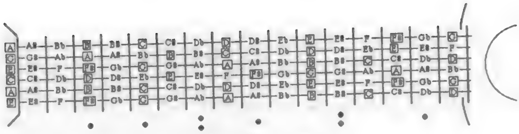
Perhaps because the pitches of the strings are close together, there are many compact easily fingerable 4 note chords, though there seem to be no 6 string "power chords." This tuning will likely appeal more to light pickers than to hardrockers (are there any hard rockers in the just intonation scene?). The ninth chords seem particularly striking, more reminiscent of a "sus 2" feel than the harsher 9th.

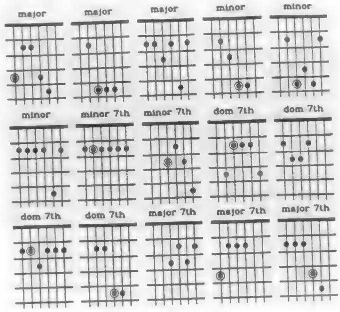
The Accidental Tuning



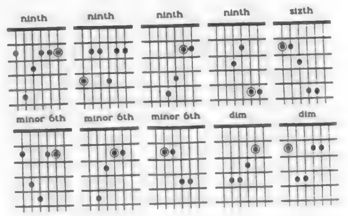
THE OPEN MINOR SEVENTH TUNING

Open tunings tend to have numerous 6 string chords, and the open minor seventh tuning is no exception. There are patterns to the major scale fingerings which make this tuning particularly simple, and there are nice feeling regularities in the open stringed chords. This is probably the easiest of the three 19 tone ET tunings to learn. It's certainly the one I feel most comfortable with.





The Open Minor 7th Tuning



LOOKING AHEAD

There is clearly an upsurge of interest in retrofretting guitars to nonstandard scales and considerable MIDI guitar activity. Hopefully these "new" instruments and tunings will help loosen our ears. Beyond the three tunings introduced here are a world of possibilities. What general strategies can one adopt when playing on a new fretboard? The idea behind the all fourths tuning is that regular tunings often provide a relatively simple set of chord patterns because all chord forms are moveable side to side across the strings as well as up and down the fretboard. The idea behind the open minor seventh tuning is that by tuning the open strings to harmonious intervals, numerous other chords will tend to be readily available. And, or course, every temperament has its own accidental tuning.

REFERENCES

1. Comments in the 19 equal tempered tuning file from the software Tune Up, Antelope Engineering, 1048 Neilson St., Albany, CA.

2. John Chalmers, "The Nineteen-Tone Instruments of W.A. Piehl and Tillman Schafer," **Experimental Musical Instruments**, April 1989.

3. Scott Wilkinson, **Tuning In**, Hal Leonard Books, 8112 W. Bluemound Rd., Milwaukee, WI, 1988.

4. While quite useful for beginning explorations in 19 ET, this analogy can break down rather spectacularly, sending one's ears scurrying for cover. For example, a 12 ET diminished chord is composed of a symmetrical pile of consecutive minor thirds D-Eb-Gb-A-C, while a 19 ET chord with consecutive minor thirds (using the analogy that a minor third equals 5 19th steps) would give C-Eb-Gb-A#-C#. These quite different sounding tone clusters show that 19 ET chord constructions and nomenclature can be sensitive to harmonic context. Though such ambiguities may arise, we can still benefit from the convenience of standardized chord definitions at the expense of occasionally shedding certain expectations carried over from 12 ET.

5. All three of the compositions mentioned are from **Sequences and Consequences**, Bill Sethares, Rivendell Studios, 622 N. Henry St., Madison WI.

6. Buzz Kimball, "Retrofretting for Non-twelve Scales," **Experimental Musical Instruments**, April 1988.

CONJOINED STRING SYSTEMS

By Bart Hopkin

EMI's discussion of conjoined string systems appears in two parts. In this first half we introduce the idea and describe its acoustic effects. In the coming issue we will follow up with a report on the work of several builders who have explored conjoined string techniques.

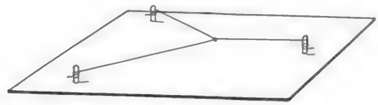


FIG. 1: A THREE-STRING SYSTEM, which can be created by tying a second string to the middle of an existing string and tightening it so that it pulls the existing string into an angle forming two distinct string segments.

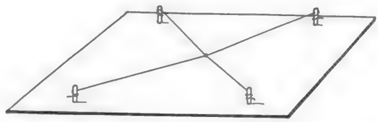


FIG. 2: A FOUR STRING SYSTEM, consisting of two crossed strings, joined at their intersection.

FIG. 3: Two strings connected end-to-end do not created a two-string system; they just act like a single string.

Imagine a musical string which, instead of having both ends attached to fixed anchors, has one end attached to the midpoint of another stretched string. What would this configuration sound like when one or the other string is plucked? How would the strings affect one another's patterns of vibration; how would the two together behave acoustically? Taking the question further, how would a complex system of several attached strings behave?

Only a few instrument builders, to my knowledge, seem to have touched on the possibilities of multiple string systems. But the acoustic results do turn out to be quite interesting – unwieldy in many ways, but intriguing, and sometimes quite beautiful. The plucked tone is generally a blend of many discernable pitches arrayed in peculiar nonharmonic relationships, an effect that haunts the dusky territory at the border of timbre and harmony. It often superficially resembles, on first impression, a large bell or gong. But unlike metal percussion, string systems are highly flexible; they lend themselves to manipulation both timbrally & melodically.

This article takes the form of a preliminary investigation of multiple-string systems, how they function acoustically and how they can be used musically, with an emphasis on three-string systems. This will be followed in EMI's June issue by short reports from each of several instrument builders who have worked in the area.

The simplest multiple string system, it would seem, should be a two-string system. But this turns out to be a geometric anomaly. The simple system described above, with the end of one string tied to the mid-point of another, is actually, for acoustic purposes, a three-string system. That's because the end-tied string divides the other string. When the strings are tautened, the end-tied one pulls the other into an angle at the connection point, and the two resulting half strings vibrate with virtually the same degree of independence from one another as from the other string. The resulting configuration is a (probably asymmetric) three pointed star, behaving essentially as three strings joined at the middle (FIG. 1).

By similar reasoning, you can see that two strings arrayed like an X, joined at the point of crossing, will behave like a 4-string system (FIG. 2). On the other hand, two strings each anchored at one end and joined end to end at the other with a knot or other connection will, once tautened, simply form a straight line and amount, in effect, to a single string (with its weight a little oddly distributed if a knot is present) (FIG. 3).

As it happens, there are ways to create arrangements that will simulate a two-string system. I use the word 'simulate,' though, because it is debatable whether these configurations constitute multiple string systems in the same sense that other configurations discussed in this article do. For that reason I've separated the "two-string simulation" information from the body of the article and put it in a sidebar appearing near the end. Let us, meanwhile, take the next logical step and look at three string systems in the star-shape described above. First, some preliminary notes.

PHYSICAL DESCRIPTIONS FOR 3-STRING SYSTEMS

For a multiple string system to work as described here, the strings must not be very different in mass, since, if they are, impedance mismatches will inhibit the transmission of vibrations from one string segment to another. So, for the purposes of this discussion, we'll be assuming that all strings in a multiple string system are in the same ballpark, mass-wise.

For experimentation and research only, it can be helpful if each of the three segments vary somewhat in length. This helps ensure that each string's input into the system is distinct and identifiable.

There is some ambiguity, in discussing the several sounding pitches of a multiple-string system, regarding what should be called a fundamental tone and what should be called an overtone. Suffice it to say here that there are several prominent tones in a typical 3-string tonal cluster that we'll treat as fundamentals in their own right for the present pur-

poses, and that this seemingly odd use of the term (multiple fundamentals?) does reflect a certain physical logic.

Let us now take note of some important properties of conjoined string vibration. Multiple string systems have restrictions on their possible modes of vibration that individual strings do not have. Single strings operating in their transverse mode of vibration (which is the important one for musical purposes), can vibrate through two dimensions. To see this, imagine you are looking at a vibrating string from above, and think of the movement of a single point on the string. That point can move up and down or side to side. It can also move in an elliptical motion that incorporates both the up and down and the side to side motions. In sum, it is free to move about in a plane perpendicular to the length of the string. Reflecting the fact that it can move through two dimensions, it can be said to have two degrees of freedom. In transverse vibration it cannot move back and forth in the direction of the string; it is restricted in this third dimension.

In physical form, single strings can be thought of as one-dimensional. One could say that this accounts for their being free to vibrate through the other two. Three-string systems, on the other hand, are two dimensional. The three anchoring points determine a plane, and when the three strands are tightened between those points, they invariably lie in the same plane. This leaves only one degree of freedom. If you imagine yourself looking down on a three-string system from above, any given point can only move up and down when the system vibrates as a whole. Meanwhile, however, the three string segments individually retain their two degrees of freedom, since they can still act like single strings each running from an outer anchor point to the conjunction point at the center. It is only whole system vibrations that are limited to one degree of freedom.

Drawing by Robin Goodfellow

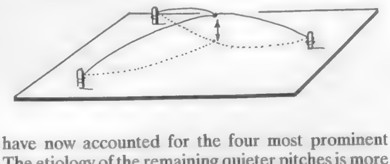
An important element in the vibrating patterns of multiple string systems is the mechanism which allows the individual string segments within the system to vibrate independently like normal strings, and at the same time to partake in larger vibrations incorporating the whole system. Central to this is the partial-barrier effect: In a three-string system, the point of conjunction is more restricted than the remainder of the individual string segments, having one degree of freedom (it can move vertically but not laterally) while the remainders of the string segments have two. The result of this is that vibrations in the vertical direction — allowed by both the individual strings and the conjunction point — can cross the barrier of the conjunction point and involve the whole system. Vibrations in the lateral direction cannot, and so they remain restricted to the individual segments.

The several inharmonic tones present in multi-string blends seem much more prominent to our ears than the harmonic overtones in normal strings. They may in fact be stronger, but there is a psycho-acoustic effect at work here as well: we perceive harmonic overtones as blending in; their simple frequency relationship reinforces the fundamental; they therefore are easily subsumed, in our ears, into the general timbre. Since blatantly inharmonic tones can't hide in the same way, they tend to conspicuous.

These thoughts will help us to understand what's going on in a typical three-string system. But bear in mind that sorting out the profusion of inharmonic pitches that sound when a three-string system is plucked is extremely difficult. Where does each of the pitches come from, and why do they appear in the relationships that they do? We won't have all the answers here, but we will give it a good listen.

There generally are four outstanding pitches produced by three-string configurations, plus a few more identifiable but less conspicuous ones. Within this pattern their relative prominence varies, and different ones can be made to dominate, depending on the location and direction of plucking. Three of the pitches are easy to isolate and identify. They are the fundamentals of the three string segments. You can verify them by damping two while plucking the third in order to hear its tone alone. If you then pluck the whole, un-damped system again you will be able to hear that individual string's tone in the blend.

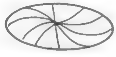
We can pin down one other pitch in the tonal blend with some confidence. There always seems to be one tone which is quite a bit lower than the others. A sharp observer will notice that it sounds most clearly when the direction of plucking is perpendicular to the plane of the strings, and that it scarcely sounds at all with an in-plane pluck. That perpendicular direction happens to be the direction of the one degree of freedom of the whole system. Thus we have here what can be called the whole-system fundamental, with all three strings moving up and down together in a pattern something like this:



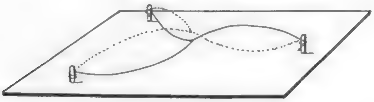
We have now accounted for the four most prominent pitches. The etiology of the remaining quieter pitches is more elusive. It seems likely that they are not fundamentals in their own right, but overtones of the low whole-system fundamental. What form, then, would those modes of the whole-system fundamental take? We can draw here on insights from both normal strings and — since a three-string system is a little like

a string extended into an incomplete membrane – certain patterns of vibration found in drumheads. The second mode for strings can be diagrammed thusly:

And an analogous mode in a circular membrane would be this:



Now we can see the form of a likely second mode for the three-string:



There may in fact be multiple versions of this mode occuring simultaneously, corresponding to different combinations of one up and two down. The resulting pitches should be roughly in the same range as the individual string pitches, as indeed some of the unaccounted-for sounding pitches usually are.

PERFORMANCE POSSIBILITIES

Some fascinating and sometimes exasperating aspects of three string systems appear when one varies the individual string lengths or tensions within the system. To begin with, individual tensions cannot be controlled. Consider a system in which the end away from the center of each segment is attached to a tuning pin. Increased tension on any one string is instantaneously distributed throughout the system; all three individual strings will rise in pitch, as well as the whole-system fundamental. Turning one tuning pin also has the effect of marginally shortening the associated string, and lengthening the other two, as the increased tension pulls the center joining point closer to the tightened pin. By adjusting all three pins in varying amounts you can deliberately move that center point anywhere within the triangle defined by the pins, and so you can control string length relationships at will. But in doing so you are also altering tensions and resulting pitches, and attempts to predict and analyze the effects for musical purposes are likely to prove to be impractical and a headache.

Altering string lengths while keeping tension constant gives rise to similar anomalies. You can alter string lengths by means of a slide or bottleneck (any heavy, hard, smooth object which can be slid along the string to form a movable stopping point), or, less fluidly, you can insert small movable bridges under the strings at chosen points. This still does not grant you real control, however, because shortening one string unavoidably alters other pitches in the system. More precisely, it affects all pitches except those of the other two individual string segments and their harmonics. Thus, as with tension alterations, each change creates willy nilly a whole new set of pitch relationships to contend with.

In short, it generally is not practical to try to tune a three-string system in a prescriptive manner (with an exception noted below). Yet a bit of fiddling around is sure to yield any number of chance tunings of beauty or interest. Given the potentially disorienting complexity of the musical results, it is worthwhile sometimes to deliberately tune two of the segments of the same gauge to the same length and pitch, thus reducing the number of different tonal elements in the mix. Carrying this idea further, when three string segments of the same gauge are tuned to the same length and pitch, the whole-system fundamental sounds at a pitch just slightly flat of the octave below the pitch of the three strings. The true octave would sound were it not for the added mass inevitably added at the center by the loop or whatever other means was used to join the strings. No other pitches sound in this tuning; complexity is replaced by simplicity. This approach, the exception to the rule mentioned above, yields results that are predicable and controllable (also less interesting).

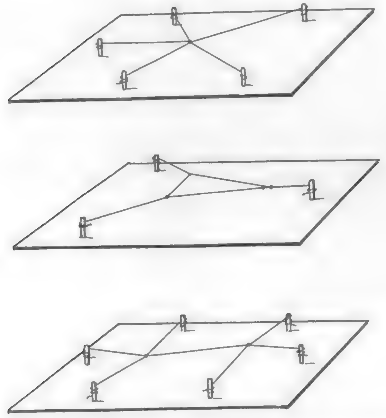
I said above that varying the length of one of the strings affects different tones within the pitch complex differently. This fact gives rise to some of the extraordinary musical potentials of three-string systems. Simply plucking and running a slide along one of the strings creates an utterly unique effect in which some tones remain unchanged, some gliss rapidly and some gliss more slowly. If, as is often the case, the portion of string behind the slide also continues to sound, you get an additional simultaneous gliss in the contrary direction. A slow vibrato on one of the strings produces a profusion of divergent motions commingling into luxuriant chorusing and flanging effects. Using the slide unslidingly to play melodically on one of the strings creates a mix of drone tones and changing harmonies of a sort no one would ever otherwise dream up.

Between these and any number of other special techniques you can do a great deal with a single three-string system. However, the peculiar tonal relations of such a system, present to some degree in every plucked note, may tend to grow tiresome before long. And so it can be worthwhile to create an instrument which holds several differently-tuned multiple-string sets. Some of the instruments that will be described in the next issue's follow-up to this article take this approach.

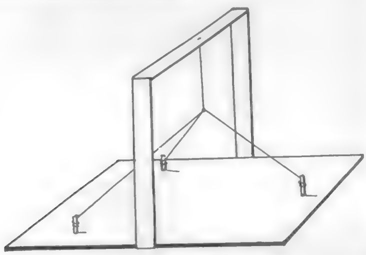
FOUR- AND MORE-STRING SYSTEMS

Thus far we have spoken only of three-string arrangements. The musical results, even from this simplest instance of multiple-stringitude, turn out to be extremely complex, and it's hard to imagine wanting to add new layers of complexity. Still, four- five- and n-string systems are fully possible. It's tempting to envision great networks of strings arranged to somehow manifest some madman mathematician musician's mad mathematical musical scheme. There are some restrictions on the form such systems could take, however. The primary one is this: recalling our earlier discussion of vibrating systems with one or two degrees of freedom, one can easily unintentionally create a system with no degrees of freedom – one that can't move. Systems which lie in a single plane (as three-string systems inevitably do) will always have freedom to move perpendicular to that plane. Four- and more-string systems can occupy three dimensions, and, depending on their configuration, may lock themselves into immobility. The simplest example would be a system of four strings joined at a single central point, in which the four end points are arrayed in space like the corners of a triangular pyramid. In such a situation, the various segments will remain able to vibrate independently, like normal strings, and may also create interesting timbral effects through some degree of sympathetic vibration, but there will be no joint vibration of multiple strings. Any system existing in three dimensions, in fact, will not be capable of whole-system vibration modes. Yet such systems may still incorporate functional subsidiary single-plane systems, as can be seen by a perusal of the possiblities on the following page.

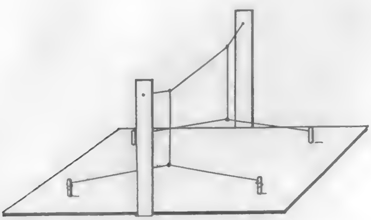
SOME POSSIBLE FOUR- AND MORE-STRING SYSTEMS



The three configurations shown above all lie within a single plane, and so are capable of modes of vibration incorporating all strings, as well as various subsidiary modes.



This three-dimensional pyramidal configuration has zero degrees of freedom for the system as a whole; it is locked into immobilibty aside from the private modes of the individual string segments.



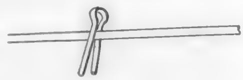
This three dimensional system, like the one above, is incapable of any whole-system modes of vibration. But is has several subsidary modes involving multiple string segments.

2-STRING SYSTEM SIMULATIONS
And Related Approaches to Inharmonic Strings

As mentioned in this article, the idea of two conjoined string segments is a geometric anomaly. Yet there are ways to create string configurations that will act very much as we would expect a theoretical 2-string system to act.

From an acoustic point of view, one of the main features of multiple-string systems lies in the peculiar blend of independence and interaction between several string segments. Each one is capable of vibrating as if it were an independent string, while at the same time also sharing in modes of vibration that involve the other string segments too. These simulations are designed to create this partially-independent/partially-interactive behavior on the part of two conjoined segments.

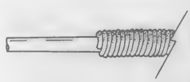
The simplest approach is familiar to prepared piano fans. A small weight made fast to a string somewhere near the midpoint will effectively divide the string into two segments. People have used small screws and nuts in various ways for this purpose; another easy approach is to use a short section of a small cotter pin, which will pinch and hold well enough at least for informal experiments. Whatever form the weight takes, its size should be appropriate for the string in question; the behaviors described here won't occur if it is very small or very large.



With an appropriately-sized weight in place, the string will manifest the sort of exotic mix of sounding tones that is characteristic of multiple string systems. The brazenly inharmonic partials make themselves plainly heard the moment the string is plucked. A little investigation will reveal that two of the tones correspond to the pitches of the two string segments on either side of the weight; a third is a low whole-system fundamental based in the entire string length with the added weight. Other audible tones are presumably either irregular overtones of the whole system fundamental or harmonic overtones from the two half-strings. What happens here is that the weight acts much like the joining points between strings in three- or more-string systems: It provides a partial barrier to waves initiated in one or another segment, reflecting a portion back to allow for normal vibration of that segment alone, and allowing another portion to cross and partake in whole-system modes of vibration.

The total sounding blend with weighted string arrangements like this is not as complex and rich as with three strings systems, so results may not be quite as impressive. Still, you can do many of the fun things that are possible with multiple string systems, such as the exotic sliding and pitch bend effects. There is the added advantage that weighted string arrangements can easily be created on existing string instruments, opening up a lot of possibilities. This area has been explored in the prepared piano repertoire, but that needn't be the final word. Harps and guitars can do some things that pianos can't. Fretting on weighted strings, for example, can produce very unusual effects not available on prepared pianos.

Another way to approximate a two-string system is to connect two strings of substantially differing linear density.* When tautened, they will simply form a straight line, but the sound of the double string will richly manifest the peculiar, gong-like inharmonic clustered tone of multiple-string systems. A practical way to create such a string is simply to remove the winding from approximately half of an overwound steel guitar string, applying a tiny drop of solder where the winding ends if further unraveling threatens.



If no solder or other mid-string weight is used, then this arrangement will differ from true multiple-string systems in that the individual string segments will not have well defined separate vibrations and the two segments will not each contribute their own distinct frequency to the overall blend. It will none-the-less generously produce the prominent inharmonic overtones we've been seeing. On the other hand, if sufficient extra weight is present at the point of junction, it will provide the needed partial barrier, and the system will behave like a more sophisticated version of the simple weighted string described above.

* The idea of connecting two strings of differing linear density and this simple way of doing so were suggested to me by Professor Donald Hall, who in turn got the idea from Professor Tom Rossing.

TEN-FOOT FIDDLES AND TWO-STORY HARPS

By Edwin Teale

This is the second in a series of reprints currently appearing in EMI, featuring early 20th century popular magazine articles devoted to unusual musical instruments. "Ten Foot Fiddles and Two-Story Harps" originally appeared in Popular Science Magazine in 1938.

Fiddles with three necks instead of one; a harp so large you can play it from a second story window; a fourteen foot bass viol, the biggest in the world; combined harps and fiddles which require two musicians to operate — such are the musical curiosities that Arthur K. Ferris, a landscape gardener of Flanders, New Jersey, has produced in his spare time.

Eventually, he hopes to assemble a vast oddity orchestra comprising 126 unusual instruments. He has worked out designs for all of them and has twenty completed and a dozen more under construction. In many instances, he picks out a tree, cuts it down, and saws it into the boards from which he shapes the instruments. Ordinary carpenter tools and a few specially curved knives which he designed and made for himself, form the implements of his craft. With these simple aids, he works over periods ranging from a few days to two years, during spare time, to complete one of his original music makers.

His hobby started one winter about a dozen years ago. Ferris was caretaker for a New Jersey estate. During the cold months, he had virtually no work to do and began making musical instruments to occupy his time. In Wisconsin, where he was born in 1872, he had tried his hand at turning out crude fiddles. But now he commenced producing original creations, instruments unlike any others on earth. They range from a tiny "angel" violin, barely a foot and a half long, to a 300-pound Goliath among fiddles, the world's biggest bass viol. It stretches fourteen feet from top to bottom and its great strings are 104 inches long. It can go ten tones lower than a piano.

Even more massive is another product of Ferris's upstairs workshop. This is the biggest harp in the world. Completed only a few weeks ago, it tips the scales at more than 400 pounds. Eighty-three of its ninety-nine strings are made of steel. Some of these vibrating wires are nearly 100 inches long. One unusual feature of the mammoth harp is a row of double

LEFT: Arthur K. Ferris, amateur maker of odd musical instruments, at work on a violin in the upstairs workshop of his home at Flanders, NJ. In his unusual hobby, Ferris uses ordinary carpenter tools and a few special knives of his own design. He sometimes works for two years on a single instrument.

BELOW: Mrs. Ferris with the "whispering harp" which her husband made for her as a birthday present.

strings forming a series of V's. Opposite strings are tuned differently. When one is plucked, sympathetic vibrations are set up in the other, and unusual tonal effects are produced. Two or more musicians can play on different parts of the great harp at the same time.

To help in playing the largest of his instruments, Ferris has constructed a platform five feet high and about eight feet square. Around it, the ten players who have appeared with Ferris in concerts in several eastern towns group themselves with their odd assortment of instruments. Five of these players are distant relatives of the late John D. Rockefeller. Another is Herbert Colburn, one of the fiddlers hired by Henry Ford some years ago, when the Detroit manufacturer tried to revive old-time country dances.

Among the unconventional instruments these musicians play is a curious "bridal lap harp," a combination of harp and violin. It requires two players to operate it. While a woman plucks the harp, a man moves a bow across the violin strings. The result is a curious duet from a single instrument.

As a present for his wife on her sixtieth birthday, Ferris designed a huge "whispering harp." The sound from the vibrating strings grows in volume as it enters a large violin-shaped body to which the harp is attached.

Another unusual version of a violin is an instrument with a curving arm rising above the neck to support vertical catgut strings that descend into the body of the fiddle. The instrument is played like a conventional violin. The vertical strings, according to the maker, give added volume to the music.

RIGHT: Combining harp and violin, the "bridal lap harp" requires two musicians to play it. One plucks the strings of the harp, whicle the other uses a bow on the violin strings in the ordinary manner.

Before Ferris took up his unusual hobby, he could not tell one note of music from another. It was after he made his first instruments that he began learning how to play them. Even stranger is the fact that he possessed little natural ability as a carpenter. He had difficulty in driving a nail and sawing a straight line. Yet, the exquisite workmanship shown in some of his instruments is amazing. Two of the violins made by this self- taught craftsman have sold for $500 apiece, and similar

BELOW: A trio of "violinettes." These queer instruments are violins fitted with extra strings that enter the body from a curving overhead arm. The players are members of Ferris's unusual orchestra.

RIGHT: This is the largest harp in the world, with strings nearly 100 inches long. A raised platform is needed in playing it. Two musicians can use it at once.

sums have been offered for others.

In his work, Ferris employs a wide variety of different woods. He has used spruce, cedar, sassafras, tulip, willow, ailanthus, thuja, ebony, crab apple, black walnut, bird's eye maple, and even poison sumac! The last-named material was employed in the inlay on the back of a curious fiddle which had the shape of a wide mandolin.

Only by testing wood can Ferris determine whether it is suitable for his work. Once he cut down two spruce trees that grew close together and looked exactly alike. Even when he had the trunks sawed up into boards, he could not detect the slightest difference between them. Yet, when he thumped the wood of one tree, it gave off a clear, bell-like tone; when he thumped that of the other, it responded with only a dull, leaden sound. In some mysterious way, the tone is a characteristic of the wood.

With its neck taken off, the "suitcase viol" provices a carrying case for smaller instruments.

Another outstanding instrument in his collection was made from a discarded cedar stump. Once he bought a large sassafras tree, an oak, and a beech, all for five dollars. Out of this raw material he fashioned several of his instruments. The most he ever paid for a single tree was twenty-five dollars. A willow which he bought for this sum possessed unusual tone quality.

As often as not, he shapes his novel additions to the orchestra from green unseasoned wood. He says he can notice no difference in the tone of the instrument before and after the wood has completely dried out. Only rarely does he buy seasoned boards.

To build his giant fiddle, however, he had to get the wood for the body from of Newark, NJ lumber yard. It came in the form of a left-over end from an immense plank of airplane spruce which had been shipped from Oregon. Sassafras was used for the neck of the fourteen-foot instrument. The total cost of the biggest harp and the biggest fiddle ran to only a little more than fifty dollars.

A few weeks ago, the booming tones of the big bass viol were heard from coast to coast when the Ferris musicians performed on a nation-wide radio program. Inquiries relative to concerts by his unique orchestra have reached Ferris from as far away as Ohio. The owner of a cabaret recently offered him twenty-five dollars a day for a personal appearance with the world's largest fiddle. Devoutly religious, he turns down most offers, as he will permit nothing but sacred music to be played on his instruments.

One of the oddest of all his odd creations is what he calls his "suitcase viol." It is a large fiddle with a stout, rectangular body which can be opened up in the manner of a suitcase. Ferris can store the neck of the viol as well as three or four small violins inside of it. Snapped shut and enclosed in a canvas cover, the instrument body forms a case which can be carried as luggage. Before he started construction of this double-purpose instrument, he measured the space between the seats of railway coaches. The suitcase viol is just the right size to slip into this space so it can be taken on railway journeys made by the orchestra.

Experimental Musical Instruments *thanks John Maluda for calling this article to our attention and providing a copy of the original printed pages, Sheryl Fiorello for assistance in obtaining permission to reprint, and Times Mirror Magazines, Inc., for granting permission.*

NOTICES

LARK IN THE MORNING MUSIC CELEBRATION 1991 will take place July 26-August 3rd among the redwoods of Mendocino County, California. There will be workshops in a huge variety of musical styles, employing a great range of instruments from around the world; plus jam sessions, dances, food, camping, etc. For information: Lark in the Morning, PO Box 1176, Mendocino, CA 95406; (707) 964-5569.

Will trade issues II-1, III-1, 2 & 3 of EMI for issues IV-2, 4 & 5. Fred Lipsett, 37 Oriole Dr., Gloucester, Ontario, Canada K1J 7E8.

Now available on CD: CHRIST HALL, a composition by Thomas Bloch, commissioned for last year's glass music festival in Sarrebourg, France. It is scored for synthesizer, male soprano, and six glass instruments. Performers on this recording constitute a who's who in glass music. Available from Glass Music International, 2503 Logan Dr., Loveland, CO 80538.

The 2nd International Jew's Harp Congress will take place in Yakutsk, Siberia, from June 18 to June 26 of this year. For more information contact Frederick Crane at 930 Talwrn Court, Iowa City, IA 52246.

Francisco López, sound artist working in the field of environmental sound, is interested in tape exchanges with others working in the same area. For a copy of his exchange catalog, write him at Apartado 2542, 28080, Madrid, Spain.

QUARTZ CRYSTAL "SINGING" BOWLS – perfect musical instrument – each bowl plays a different musical note – especially helpful for music therapy – the bowls make people smile – they are perfect stress eliminators – 12 sizes – frosted & clear – chakra-tuned – all credit cards accepted – The Crystal Store – 1-800- 833-2328.

New releases from NONSEQUITUR / ¿WHAT NEXT? **Aerial** #2 (68 min. cassette; 24 pg booklet) includes music of Jin Hi Kim, Christopher Shultis, Annea Lockwood, Hildegard Westerkamp and other sound source explorers. The **Soundviews: Sources** cassette (reviewed in EMI VI - 2), **Aerial** #1 and other materials also available. Nonsequitur Foundation, PO Box 15118, Santa Fe, NM 87506; (505) 986-0004.

THE ONLY BOOK IN SAWING: **Scratch My Back: A Pictorial History of the Musical Saw and How to Play It**, by Jim Leonard and Janet Graebner. Features profiles of sawyers world-wide in 124 pages of fascinating information. Includes over 100 photos and illustrations, index and bibliography. U.S. Dollars $19.95, $3 shipping/handling (in CA add 6% tax). For information, contact Janet E. Graebner, Kaleidoscope Press, 28400 Pinto Dr., Conifer, CO 80433.

MOUTHSOUNDS

By Frederick R. Newman

Published in 1980 by Workman Press, 708 Broadway, New York NY 10003.
127 pages plus a bound-in floppy vinyl soundsheet; $6.95.

Reviewed by Bart Hopkin

"How to whistle, pop, click, and honk your way to social success" reads the legend on the cover of this book, with the additional notes "A practitioner's manual," "More than 70 noises to make with your mouth," and, finally, "Includes free record."

Most children delight in making funny noises. Some develop their abilities to the point where they can become class clowns; a few, with continued cultivation, carry their skills into the adult workplace and the sports arena. At least one, it turns out, has written a book.

Frederick R. Newman takes a mock-formal sort of approach in **MouthSounds**, with pompous language and his own mouthsound performance photos posed in tux and bow tie. The idea is to have fun with what might be considered an undignified subject matter. At the same time he does, in fact, do a workmanlike job of conveying a great deal of information about how to make a goodly number of mouthsounds. Verbal descriptions, photos, diagrams and the recordings combine to describe his techniques quite clearly – and that's good, because many of the anatomical maneuvers involved are not the sorts of thing that are easily explained.

The first sections of the book are devoted to the anatomy of the vocal apparatus, along with additional background information on such topics as hearing, the origins of speech, castrati and coughing. These topics are presented superficially and not very authoritatively. They are followed by the descriptions of the mouthsound techniques, which comprise the main body of the book. Each of Newman's sounds is allotted a page or two. That includes text explaining the technique plus suggested uses, cartoon-like diagrams, and comical photographs of demonstrations by non-professional models.

Many of the mouthsounds are common and familiar; typical readers will probably have heard and seen most of them at one time or another, and tried at least a few of them. These include things like: *the ploit*, which involves using one finger for a short, sharp rap to the cheek while controlling pitch by using the mouth aperture size to modulate oral cavity resonance; *hand coos*, which is Newman's term for the kind of whistling where you form a globular chamber with both hands and blow across a small opening between the thumbs; and *the tongue flop*, in which one creates and then abruptly breaks a vacuum behind the tongue by placing the tip on the roof of the mouth and drawing it down until the seal suddenly opens, causing a short, loud pop as air rushes in. Naturally Newman includes a great many variations on lip buzzes both tight and blubbery, as well as *the palate grind*. The latter Newman's name for the rough sound children often use to imitate guns, produced by forcing a stream of air through a point near the juncture of the hard and soft palate, partially blocked by the back of the tongue. Mouthsound techniques that were new to me here include an additional form of cheek music (involving pinching and releasing) and some varieties of clicks.

Some of Newman's most interesting effects arise from the combination of two or more basic techniques. For instance, his pleasantly musical *Water Drip* is a blend of *the ploit* (cheek percussion with oral resonance) plus a short ascending whistle, generated by moving the tongue forward to force a small rush of air through pursed lips. The *'62 Buick*, performed on the record with remarkable presence and realism, is a combination of palate grind and a very loose lip buzz.

Newman also makes the assertion (news to me) that the most effective animal sounds can be made through inhaling. Sure enough, his inhaling dog bark sounds much more doglike than the average human's exhaling dog bark imitation. The principal proves especially effective for pigs and frogs.

The best part of Newman's effort is the record that comes with the book. Adding to the comic effect of the sounds is the fact that, perhaps because there was a shortage of time available on the disk, the presentation is exaggeratedly fast paced. This gives it a slightly frantic quality. Newman announces each technique talking faster than a top forty disk jockey, and the sounds tumble out in relentless succession. It becomes clear, on hearing the sounds after reading the descriptions, that the physical techniques are less than half the story; the effects owe much of their success to Newman's timing, pitch sense, and good ear. Some highlights of the record are: a top quality trumpet imitation (both open and muted), the bubble effect, and a fully three dimensional game of ping pong.

PATENTING FOR MUSICAL INSTRUMENTS

By Bart Hopkin

Does it make sense for the creator of a new musical instrument to seek a patent?

Much of what appears in EMI from issue to issue concerns newly invented musical instruments. The question of patenting naturally arises. And, indeed, several of the builders whose work has appeared in these pages have patented their ideas. But there are many facets to the question of patenting. This article will provide some general sense of the ins and outs of patenting in the U.S., along with some thoughts on patenting as it relates to musical instrument design in particular.

Please bear in mind that this is not an authoritative treatise on patent law. Anyone seriously interested in applying for a patent will want to turn to one of the books written by specialists in the field, and/or to a patent attorney. A couple of good books and several other resources for further information are given at the end of the article.

WHAT IS A PATENT?

A patent is a grant from a national government allowing the patent holder the right to prevent others from making, selling or using the invention covered by the patent. A patent may be granted on a process, machine, product ("manufacture") or substance ("composition of matter"). Items falling in some other limited categories, such as biological varieties or ornamental designs, may be candidates for patent protection as well. For inventions meeting these descriptions, there are three criteria for patentability: The idea must be novel, useful, and "not obvious to one skilled in the art." "Novel" simply means new; if the idea behind the invention was previously known or is determined to be covered in another patent, no patent will be granted. The "not obvious" phrase serves to exclude patents on ideas which required no original thought. "Useful" should be self-explanatory; judging from some of the peculiar inventions that have proven patentable, it is broadly construed.

Patents can only be granted to the true inventor (not, for instance, to the inventor's employer -- though the patent rights can be transferred to the employer). A patent cannot be granted on an idea which was publicly disclosed more than a year prior to the date of patent application. Thus, if an inventor publishes an article about his or her idea, or demonstrates it in public, and then waits too long before applying for a patent, the patent will be denied. Except in special categories, patents granted by the U.S. government remain in force for 17 years from the date of issuance.

In order to obtain a patent, you must of course disclose your invention to the patent office. The idea is held in secrecy as long as the patent is pending, and once the patent is granted or denied it becomes public information. Thus, deciding to rely on patenting to prevent others from copying your idea amounts to deciding not to rely on trade secrets, since it will no longer be secret; conversely, deciding to rely on secrecy amounts to deciding not to patent the idea. The fact that all patents ever granted are now public information has one important result: patent libraries, where records of past patents are kept, are TERRIFIC repositories of ideas and information, such as you'll find nowhere else.

Patents in practice offer less protection than one might think, especially for individuals lacking the resources of corporate patent holders. While a patent grants certain legal rights, it remains up to the patent holder to enforce those rights. It's one thing for two corporate giants to fight it out in a patent infringement case, where both sides are well funded and well represented, and high stakes justify the costs involved. It is another for a self-employed part time instrument maker to try to track down some small-time infringer living a few states away and drag him into court.

WHAT ARE THE PROCEDURES FOR OBTAINING A PATENT?

If you have come up with an invention that you think may be patent-worthy, it will be important to document the process of invention and related dates, keep records of related correspondence and so forth. Your next step will be to conduct a patent search to discover whether anyone else has already patented the same or a very similar idea. There are professionals who will do this for you, and probably do a better job. Doing it yourself, on the other hand, although difficult, is extremely valuable, rewarding, and, yes, fun. The patent search serves several purposes. It may save the expense, effort and disappointment of an undertaking that is doomed from the start. Equally important, it fills you in on what has been done in your area and helps you place your idea in the context of related developments. You may be surprised by how much you learn about your own invention, its strengths, weaknesses, potential and overall value, by looking at others' work in the same area. The search also allows you, when making up the patent application, to present it knowledgeably and in a way that will addresses objections that the patent examiner may have. Patent examiners actually expect this; they will naturally lend more credence to an applicant who has done the homework.

The search must be conducted in a patent library. There are U.S. Patent libraries in cities across the land, and foreign patent libraries in major cities overseas (listings appear in sources cited at the end of this article or are available from the patent office). The patent office maintains an indexing system which categorizes patents by subject matter, allowing you to locate patents on inventions relating to your own. Finding where you fit in someone else's taxonomy can be problematic, but with a little help, even a novice can eventually find his or her way. There will remain an element of hit-or-miss in any patent search, because it's impossible to determine in advance which seemingly related patents, as they appear in the indexing system, will turn out to be related to your invention in the ways that matter. You find yourself reviewing scores of patents which turn out not to be relevant.

If you're not in a hurry, nosing through all these patents -- some pertinent to the search, some not, but all presumably related to your field of interest -- can be truly fascinating. Occasionally you'll see the original patent for an invention that you know of; perhaps even one that went on to achieve some

importance. More often you'll see odds and ends that have fallen by the wayside, some seemingly valuable and others manifestly absurd or silly. You get a peculiar view into people's lives this way. Here are these reams of faceless documents full of the most formal and unnatural language; yet through them gleams always a restless spark of human hope and ambition.

If you turn up a patent that resembles your idea closely enough to render your idea unpatentable, and the patent is still in effect, you have some options. You may choose to go back to the drawing board, or, if your heart was set on manufacturing or selling the item, you might decide to contact the patent holder to see about licensing rights. If it is an older patent that is no longer in effect, you are free proceed to use the invention; by studying the patent you may even learn some things that will improve your idea. On the other hand, you may have turned up some related but slightly different ideas. You can photocopy these patents to study and refer to in preparing your own patent application. (Patents are public information, remember. You can photocopy any patent you want.)

Drawing by Robin Goodfellow

And now, the patent application. The patent application has several parts. It is a moderately complex legal document, and once again I must refer readers to the Patent Office and other sources for full information on preparing it, but I can provide some general notes here.

Aside from some formalities, most of the application is given over to description of the invention. This information is presented in several phases: the abstract, background of the invention, summary, drawings and descriptions of the drawings, detailed description of the preferred embodiment, and claims. These terms are self explanatory except the last two.

The idea behind the "preferred embodiment" is this: Many a good, patentable idea has the potential to take a variety of forms in practice. The patent office needs a full description of a practical realization of the idea; yet if a detailed description were taken as absolute, then another person might be able to retain the basic elements while altering some inessential details, and claim to have a newly patentable invention. To get around this problem, the patent office allows the applicant to describe the essential idea, and then describe in detail a "preferred embodiment," without implying that this is the only form the idea could take.

The final part of the specifications – the claims – is the section in which the applicant stakes out his or her territory. He explicitly states, in a list of numbered claims, what aspects of the idea he believes should be covered by the patent. The patent office reviews these claims individually and either accepts or rejects them. If one or more of them is allowed, a patent will be granted. The claims are the legal heart of the patent; they define just what it is that the patent will protect.

Patent specifications do not absolutely have to be written by attorneys. Conventional English (as opposed to Legalese) will do to describe the invention, provided it is clear, concise, explicit and direct. But there are some special considerations to bear in mind. One of the most important is this: Even though the description must be explicit and unambiguous, in all but the preferred embodiment portions of the application the invention should be described in the most general terms possible without compromising the uniqueness of the idea. That is, you should not limit yourself to presenting your invention in one specific form; you should try to encompass all the ways your idea could be embodied, and all the potential uses it might be put to. If you describe your idea in unnecessarily narrow terms, others may later be able to patent slight variations. If you describe it in expansive terms, you have laid claim to more territory. This has the additional benefit that it forces you to think through the broadest potential of your idea more fully than you might have before. Much of the seemingly peculiar and unnatural language appearing in patents arises from people's efforts to avoid limiting the interpretation of their claims.

It normally takes the U.S. patent office about a year to respond to a patent application. Rarely will a patent with all its claims be granted immediately. More often at least some of the claims will be rejected, and there follows a process of revisions, ammendments and appeals, all in accordance with standard procedures which we won't describe here. In the process, a revised and usually much more limited document will evolve. The process should not be an adversarial one: patent office regulations require examiners to work to help applicants, particularly those not represented by lawyers, and applicants do well to try to work constructively with examiners.

Basic U.S. patenting fees might add up to something over $200 for a fairly simple patent (if they haven't risen by the time you read this). This amount might be augmented by various incidental fees that can crop up along the way. Search fees and legal fees -- potentially much more substantial -- aren't included in these figures.

DOES IT MAKE SENSE TO PATENT MUSICAL INSTRUMENTS?

There is an element of prestige in holding a patent. It signals a unique sort of recognition. But in most cases inventors seeking patents have other things in mind -- primarily, exclusive right to commercial exploitation of the invention. On that basis, an invention is worth patenting if, first, it is reasonable to believe that it has commercial potential, and, second, there is reason to fear that others might step in to take advantage of that potential, diminishing the inventor's gains in so doing. Now, how many musical instrument inventions are likely to fit that description?

Some. In particular, the recent development of electronic keyboards, various aspects of which have been patentable, has proven fertile ground for commercial development. But most new musical instruments are at best borderline cases in this regard. The sad truth is, the more innovative a new instrument type is, the less likely it is to have the kind of commercial potential that justifies patenting. While the new electronic keyboards fed nicely into an existing market of keyboard players, an instrument which uses an unorthodox playing technique has no such advantage, no matter how dexterously the inventor may play it. Instruments with no existing standard repertoire, and instruments with no highly visible role model performers, will be at a similar commercial disadvantage regardless of the musical possibilities. The limited commercial potential of innovative instruments must be weighed against the labor and cost of obtaining a patent, and the ensuing difficulty of enforcing it for one without corporate means. A cost/benefit analysis in such cases will most often come out against patenting. Bear in mind that for all patents — not just off-beat musical instruments — less than one in ten ever even go into commercial production, and fewer still ultimately make money.

This is not to say that the kind of inventiveness that fills the pages of EMI can never prove commercially profitable. Innovative ideas pertaining to keyboards and guitars have, as noted above, ready-made markets. And there are always those few inspired instruments that produce beautiful sounds through playing techniques either close to familiar ones or easily acquired. There's also the possibility that an imaginative acoustic explorer will come up with an appealingly clever door bell, teapot whistle, or rain-activated musical garden-sculpture that finds its way to a much larger potential market. Such things could easily justify patenting.

What if you conclude in the end that patenting in your case does not make sense; yet as a matter of livelihood you'd still like to protect your rightful advantage as the originator of an idea? There are other options.

One, mentioned earlier, is trade secrets. If there's something about your invention or product that can't be ascertained by someone examining it, you may have better protection than a patent would offer. There may be something in your manufacturing process, unknown to others, that would prevent them from obtaining the same results. Similarly — although this isn't a matter of trade secrets — you might simply develop your skill as a craftsperson to where you outpace potential competition.

Alternatively, you can turn to another form of legal protection. Your instrument may be eligible for copyright as a visual design or sculpture. Copyrighting is a far simpler and cheaper process than patenting, and extends its protection beyond the 17 year life span of a patent. Copyright would not protect a new concept in sound production, but if the essence of your idea is more visual than mechanical, it may serve your purpose. You could also consider obtaining a design patent, which is subject to less restrictive rules than other patents. And it is possible to obtain a design patent on things now in the public domain and thus not eligible for a regular patent. One cannot patent a guitar, for instance, but one might be able to get a design patent for some visually unique guitar design.

With the idea of copyrighting comes the possibility of a slight change in mind-set. Pursuing patents tends to lead us to think in terms of production in quantity. But musical instruments can be seen as individuals rather than types. Rather than producing many identical instruments, one can produce many varied and unique instruments, treating them, both in spirit and legally (for copyright purposes) as individual works of art.

Finally, one can approach the whole matter differently, and live by the philosophy that most of those who contribute to EMI, and, I suspect, most of those who read EMI, have lived by all along. The essence of it is to make no proprietary claim on musical instrument design ideas one may have come up with. Whether or not one has a legal or ethical right to claim ownership of an idea, if there's nothing to be gained by placing a no trespassing sign on it, then why do so? If one is not dependent on the commercial benefits of ownership of the invention (which so often turn out to be trivial anyway), then this attitude has a great deal to recommend it. Not least is the fact that sharing is a good thing. One way to see an idea validated is to patent it; quite the opposite but fully as valid is to see others freely use it, enjoy it, and value it.

FURTHER INFORMATION ON PATENTING AND RELATED TOPICS

U.S. GOVERNMENT OFFICES FOR INFORMATION AND APPLICATIONS:

The Commissioner of Patents, Washington DC, 20301.

Register of Copyrights, Library of Congress, Washington, DC 20540.

Search Room of the Patent Office, Crystal Plaza, 2021 Jefferson Davis Highway, Arlington, VA 22202. (The Search Room is the main U.S. Government patent library; for addresses of other patent libraries, consult the patent office, phone books, or the bibliographical sources listed below.)

NON-GOVERNMENTAL SERVICES:

Patent Attorneys can be found in local telephone directories under Attorneys, Patent Attorneys & Agents, and Patent Lawyers. Patent search services can be found under Patent Searchers.

Several inventors' societies offer related services to members. A prominent one is The American Society of Inventors, PO Box 58426, Philadelphia, PA 19102.

BOOKS:

Patent It Yourself by David Pressman (1988, Nolo Press, 950 Parker St., Berkeley, CA 94710). Highly recommended, as are all the legal self-help books put out by Nolo Press.

How To Get Your Own Patent by Robert O. Richardson (1981, Sterling Publishing Company, New York).

For reviewing, critiquing and correcting this article prior to publication, EMI thanks patent attorney Larry D. Johnson, musical instrument patent holders Richard Waters and Robert Grawi, and patent reform activist Ivor Darreg.

NOTES FROM A PATENT-HOLDING INSTRUMENT INVENTOR

by Richard Waters

In response go the editor's request, Richard Waters, inventor of the Waterphone, provided these comments on his own experience with the patenting process, its benefits and its drawbacks.

My general feeling about the patent process is that unless you have something that is **really unusual** – don't bother going through the patent scene, as it is most frustrating and expensive. And at the end of it all what the patent means is that you now have the right to sue someone over any patent infringement. Sueing someone is difficult and expensive, and you probably will not recoup your money unless the person or company is financially sound. Having gone through the process myself with the Waterphone (pat. no. 3896696) I was unaware of the above until I had secured the patent. Usually, the people that are out to rip you off are minimal income types, so attempting to sue them is a waste of time and money. Plus it is difficult to get evidence without hiring a private investigator, and once the infringer knows that you are on to him, the whole scene submerges and becomes very clandestine. Having had this problem in both Los Angeles and New York, I know whereof I speak. Of course, if you do have a patent or copyright then any store handling instruments that are illegal can be put on notice that if they continue to carry these outlaw devices they are subject to legal action. I have done so with several stores in the New York area. However, none of the stores would supply me with the name, address, or phone number of the infringer even though he was clearly in the wrong.

Also, when you do get a U.S. patent, this is protection only in the U.S., so anyone seeing your invention can take your idea back to another country and start producing. I have been having this problem in Germany and there is nothing I can do about it except make a better axe than theirs.

The patent process itself is much cheaper if you do it in propria persona, which means doing it yourself without hiring a lawyer. You can simplify the process by getting a law student or legal aid to advise you as to the right moves to make, especially in making claims for your invention. These claims shoud be as wide as possible so as to cover your entire process both now and in the immediate future.

By doing the patent search and reading the patents that are the closest to yours you will get an idea of what type of claims to make about your invention. *Pay attention to all deadlines supplied by the patent office.* I did not do this and missed submitting something on time, got cancelled out of the patent process, and had to pay $180 (1968 prices) to get reinstated.

Although I now have several items I would like to get protection for, I am most reluctant due to the red tape and expense. I would suggest that a copyright might be a better solution. It is cheaper and faster, though the protection (right to sue) is not as great. Also, my basic current premise in terms of invention development is to **out-distance the competition.** Insofar as you know the ins and outs of your invention better than anyone, you also know how to push it ahead when someone starts breathing down your neck with copyitis.

I hope I have not discouraged anyone with potential ideas/inventions. I basically feel that the patent process and the laws surrounding patents need to be rewritten as they do not favor the individual inventor, who should be compenstated for his time/effort/money for the development of an idea.

... AND NOTES FROM A NON-PATENT-HOLDING MUSICAL INSTRUMENT INVENTOR

Ivor Darreg, creator of the megalyra family of instruments, the electronic keyboard oboe, and a host of other instruments, also took the time to respond to the this article prior to its going to press. Among other things, he sent along a copy of an article he wrote in 1968 and revised in 1980 (too extensive to reprint here) about his own experience with the patent system. The article, under the title "It's a Patent Absurdity!" opens with the line "And it's also a cruel joke." Mr. Darreg believes that patent systems in the U.S. and elsewhere fail to serve those they are intended to serve, primarily because of the expense of the patenting process and the brevity and frailty of the protection provided. He also expresses concern over a lack of public esteem for inventors – often depicted in fiction as dreamers and buffoons; often treated in reality unfairly and disrespectfully.

For information on obtaining a copy of Ivor Darreg's article, contact him at 3612 Polk Avenue, San Diego, CA 92104.

Recent Articles in Other Periodicals

The following selected listing contains articles relating to unusual musical instruments which have appeared recently in other publications.

"Brian Ransom" by Jo Lauria, in **Artweek** November 29, 1990.

A review of an exhibit of soundworks by the Southern California maker Brian Ransom which took place in November, 1990. Ransom makes ceramic wind and percussion instruments, quite beautiful in form.

"The 'Top' Choices in Soundboards" by John M. Larsen, in **The String Instrument Craftsman** #14, Nov/Dec 1990 (142 N. Milpitas Blvd., Suite 280, Milpitas, CA 95035).

The author discusses the properties of and the pros and cons of the four most popular string instrument soundboard woods: Sitka spruce, European spruce, western red cedar, and redwood.

"Singing skyscraper a sour note in N.Y.", from the Associated Press, December 7, 1990.

A 72-story building in New York City is driving residents and workers in its vicinity mad with its constant whistling in the wind, audible up to ten blocks away. City officials believe the sound is caused by wind whistling through louvres in the building's dome. The article reports that the architect has been issued a summons and may be required to silence the building and pay a fine.

"l'Armonica de verre, ou Glassharmonica de B. Franklin" by Thomas Bloch, in **Crescendo**, February 1991 (17 rue Pascal, 75005 Paris).

Thomas Bloch writes on the glass harmonica in this generously illustrated 10 page article.

"Niel Feather: The Mid-Atlantic's Harry Partch" by D.C. Culbertson, in **Maryland Musician** #74, November 1990.

A discussion, with some photographs, of the work of musician and instrument builder Niel Feather. His instruments include, among others, a string instrument with non-rigid sheet metal resonator, a device which uses a suspended ball bouncing off of strings mounted around a rotating pillar, another which uses vibrators swinging over a microphone, and a tension-controlled "Bendy Guitar."

"An Audible-Constructs Primer" by Lief Brush, in **Leonardo** Vol. 23 # 2 and 3, 1990 (2030 Addison St. Suite 400, Berkeley CA 94704).

In the form of a set of pedagogic inquiries, Lief Brush presents specific exercises to increase one's awareness of environmental sound and practice manipulating it for aesthetic ends.

"Image Generation Survey: Sound" by Sonia Landy Sheridan, also in **Leonardo** Vol. 23 #2 & 3 (address above).

Sonia Sheridan presents low tech means for using sound vibrations to create graphic images. Some of the techniques involve placing small amounts of photocopier toner on paper and agitating the paper with sound vibrations, or using certain models of photocopy machines which encode image making information in sound.

"Reviews" by Nicholas Von Robison, in **American Lutherie** #24, Winter 1990 (8222 South Park Ave., Tacoma, WA 98408).

The author provides a luthier's guide to literature on woods, briefly reviewing ten selected books on the subject.

"A Low Cost Bass" by Frederic C. Lyman, Jr., also in **American Lutherie** #24, Winter 1990 (address above).

Fred Lyman discusses and gives plans for a "very usable bass" made from inexpensive and commonly available materials.

"Try Cherry!" by John Calkin, also in **American Lutherie** #24 (address above).

In the search for alternatives to increasingly rare tropical woods for string instrument making, the author suggests cherry, and mentions several other possibilities as well.

"An Interview with Mr. William Ludwig, Jr." by Ward Durrett, in **Percussive Notes** Vol. 29 #3, Feb. 1991 (123 W. Main St., Urbana, IL 61801-0697).

Ward Durrett interviews the son of the founder of the Ludwig firm, maker of drums and accessories. They discuss the invention and evolution of bass drum pedals, drum shell manufacturing techniques, the manufacture of giant bass drums, and more.

"Tuning the Tabla: a Psychoacoustic Perspective" by David Courtney, also in **Percussive Notes** 29:3 (address above).

The author used a spectrum analyzer in a series of experiments designed to gain an objective sense of the frequency components of various strokes on the tabla. He relates this to the manner in which the ear interprets the tabla's timbre in terms of pitch.

Also in **Percussive Notes** 29:3, under "Notes from the Industry": a short report on Calato USA, Inc.'s patent pending Splitstix, which are drumsticks with multiple split ends, making for a more brush-like sound while retaining some of the feel of normal drumsticks.

TechniCom Volume 14 #5, Sept/Oct 1990 (PO Box 51, Normal, IL 61761) contains the usual generous helping of information on band instrument repair. Included is the first of a series on band instrument repair schools in the U.S. This first installment provides overview information on schedules, costs, residency requirements, job availability and such. Subsequent installments in the series will look at individual schools, starting with Western Iowa Technical College in **TechniCom** Vol. 14 #6.

Musicworks 48, Autumn 1990 (1087 Queen St. West. Toronto, Canada M6J 1H3) contains reviews of two festivals which included works using unconventional musical instruments. Georges Depuis' review of the 1990 **Sound Symposium** in Newfoundland highlights UAKTI, Jacques Dudon, and several other builders. Helen Hall's review of **New Music America** 1989 highlights, among others, Conlon Nancarrow and Trimpin.

1/1 Vol. 6 #3 Summer 1990 (535 Stevenson St., San Francisco, CA 94103) has appeared, containing a description of a piece of MIDI sequencer software which can be programmed for different tunings, a review of the recently released CD recording of Partch's **Revelation in the Courthouse Park**, and a several more articles relating to tuning theory.